Recommended Standards For Private Water Wells

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Introduction

Safe, potable ground water is one of our most precious natural resources. It can be contaminated and made dangerous, even totally useless for drinking, by improper well drilling and pump installation practices.

To guide well drillers and homeowners in the construction of safe, usable wells, the Indiana State Department of Health offers the following standards for construction of wells and installation of pumps and appurtenances. Whenever a well is opened for repair, the work and materials used should also comply with these standards. Dewatering wells, irrigation wells, heating and cooling supply and return wells, temporary service wells, construction water wells, process wells, and other structures for withdrawing ground water or lowering of a water table, regardless of location, length of intended service, or original use or intent, should be constructed in accordance with these standards. Where possible, existing wells and water systems should be upgraded to meet these standards. See the end of this monograph for definitions of the terms used herein.

Location Of Private Water Supply Wells

1.1 General Principles

Private water supply wells should be located:

1. In such manner that the well and its surroundings can be maintained in a sanitary condition.
2. At the highest point on the premises consistent with the general layout and surroundings, but in any case in an area protected against surface water ponding, drainage or flooding. The finished well casing or pitless adapter should extend at least 1 foot above the ground level or 2 feet above maximum flood level as determined by the Indiana Department of Natural Resources (http://www.in.gov/dnr/), whichever is higher.
3. As far removed from any known or probable source of contamination as the general layout of the premises and the surroundings permit, but in no case closer than the minimum distances specified in Section 1.2 below.

1.2 Minimum Distances from Sources of Contamination

Private water supply wells and buried suction pipes serving a residence should be installed the following minimum separation distances from potential sources of contamination:

Table 1 Minimum Separation Distances *

Sources of Contamination	Distance
Independent clear water drain; septic system perimeter drain; rainwater downspout; cistern; hydrant drain; or building foundation drain	10 feet
Property lines	15 feet
Stream; lake or pond shoreline; below-ground swimming pool; open ditch or other waterway; sanitary or storm sewer constructed of water works grade ductile iron, cast iron or PVC pipe with mechanical or push-on joints	20 feet
Watertight grease basin; septic tank; wastewater holding tank; absorption field; constructed wetland; sewage lift station; or sanitary vault privy (a privy that utilizes a solid wall wastewater holding tank)	50 feet
Stable; animal barn or feeding pen; milkhouse; livestock run; or silo	50 feet
Sanitary or storm sewer not constructed of water works grade ductile iron, cast iron or PVC pipe with mechanical or push-on joints	50 feet
Pit privy (a privy that has brick-, block-, or stone-lined pit walls); manure pile; manure holding tank; silage pit; dry well; seepage pit or trench; or cesspool	100 feet
Surface or subsurface stored chemicals such as gasoline, diesel fuel, home heating oil, fertilizer, pesticides, etc.	100 feet
Septage or treated sludge disposal area; wastewater absorption; storage, retention or treatment pond; ridge and furrow waste disposal site; or spray irrigation waste disposal site	500 feet
Uncovered salt storage	1,500 feet

*** If the well casing terminates less than 25 feet from finished grade, or if the well penetrates creviced or highly porous formations, at a minimum, the distances listed in Table 1 should be doubled.**

If the residence is located within 2,500 feet of a sanitary landfill, the Office of Land Quality of the Indiana Department of Environmental Management should first be consulted for recommendations on separation from the facility.

If the distances enumerated in Table 1 cannot be met, consult with your local health department about the potential for lesser separations based on special construction or favorable geology.

1.3 Relation to Buildings

A well should be located so the centerline of its casing extends at least 5 feet clear of any projection from the building. A well should be reasonably accessible for servicing and maintenance utilizing equipment for cleaning, treatment, repair, testing, or inspection. Except for well houses specifically constructed for the purpose, it is totally unacceptable to locate a well in a building or in the basement of a building.

Well Construction

2.1 Well Design and Construction

1. A well should be adapted to the geologic and ground water conditions existing at the site, to ensure full use of the natural protection afforded against contamination of the water-bearing formation and to exclude sources of contamination.
2. Every well should be tested for yield. The pumping equipment used should have a capacity at least equal to the pumping rate desired of the well during normal usage. Ideally, a well should be tested for stabilized yield and drawdown by pumping initially at 150% of the design pumping rate, and backing off until a stabilized yield is achieved. The test pump should be operated continuously for a minimum of one hour, continuing until the pumping water level stabilizes. A that point, the well yield and drawdown should be recorded. Bailing may be used to give a rough estimate of the yield of the well, but it is practical only for testing very weak wells. Bailing is not a reliable substitute for a pumping test when the anticipated or desired yield is more than 2.5 gallons per minute (gpm). Air lift pumping is not an acceptable method for determining yield.
3. A well should be capable of supplying sufficient water to meet required needs. Wells constructed as a source of water for a residence should have a stabilized yield of at least 5 gpm. If a well's stabilized yield is less than required, the driller should inform the owner so he or she can provide additional storage and the proper kind of pumping equipment to satisfy the anticipated peak demand for water.

2.2 Casing

1. All wells should be cased to a depth of at least 25 feet below ground surface.
2. The casings of wells developed in sand or gravel should extend watertight to or into the aquifer.
3. The minimum casing diameter for every new well should be at least 5 inches nominal inside diameter. Further, the inside well diameter should be at least 1 inch larger than the outer diameter of pumping equipment to be installed. Only those wells used for monitoring may be constructed of casing less than 4 inches in diameter.
4. Every drive pipe should be fitted with a standard drive shoe, threaded or welded onto the pipe so that the pipe rests on the internal shoulder of the shoe. The shoe should have a beveled and tempered cutting edge of metal alloyed for this special purpose.
5. The casing of the well should be steel or thermoplastic of sufficient thickness and quality to protect the well against structural deficiencies during construction, and against contamination by surface water or other undesirable materials during the expected life of the well. Only recessed couplings may be used on threaded steel casing. Steel casing should be new, first-class material meeting ASTM[1]Standards A-120 or A-53, or API[2] Standards API-5A or API-5L. Thin-walled, sheet metal, used, reclaimed, rejected, or contaminated pipe or casing should not be used in a water well. Only casing salvaged from water well test holes may be reused for well drilling. Where corrosive water or soil is likely to be encountered, thicker walled casing than that specified in the following tables should be used.
   [1]American Society for Testing Materials (http://www.astm.org/), 1916 Race Street, Philadelphia, PA 19103
   [2]American Petroleum Institute (http://www.api.org/), 1271 Avenue of Americas, New York, NY 10020

Table 2
Minimum Standards Of Dimensions And Weights Standard Line Pipe[1]

Nominal Size in Inches	External Diameter in Inches	Internal Diameter in Inches	Wall Thickness in Inches	Weight in Pounds / Foot - Plain Ends	Weight in Pounds / Foot - Treaded Ends
5	5.563	5.047	0.258	14.62	14.90

[1]Standard line pipe in these thicknesses may be threaded and coupled, or welded.

Nominal Size in Inches	External Diameter in Inches	Internal Diameter in Inches	Wall Thickness in Inches	Weight in Pounds / Foot - Plain Ends	Weight in Pounds / Foot - Treaded Ends
6	6.625	6.065	0.280	18.97	19.33
8	8.625	8.071	0.277	24.70	25.44
10	10.750	10.192	0.279	31.20	32.20

[1]Standard line pipe in these thicknesses may be threaded and coupled, or welded.

Table 3

Minimum Standards Of Dimensions And Weights Standard Pipe And Line Pipe[2]

Nominal Size in Inches	External Diameter in Inches	Internal Diameter in Inches	Wall Thickness in Inches	Weight in Pounds / Foot - Plain Ends
5	5.563	5.187	0.188	10.76
6	6.625	6.249	0.188	12.89
8	8.625	8.249	0.188	16.90
10	10.750	10.374	0.188	21.15

[2]Lighter weight pipe, meeting ASTM Standards A-53 or A-120 and API Standard API-5L, is suitable for welding only.

6. Thermoplastic pipe used for water well construction should comply with ANSI/ ASTM-F480, latest revision,"Thermoplastic Water Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR)." Acceptable thermoplastic pipe materials for water well casing are acrylonitrilb-utadiene-styrene (ABS), polyvinyl chloride (PVC), and styrene rubber (SR)

containing a minimum of 50 percent styrene and 5 percent rubber. Thermoplastic well casing should have a minimum wall thickness equal to SDR-26 for wells 100 feet deep or less and SDR-21 for wells deeper than 100 feet. All thermoplastic casing used on a well should be of the same type, grade and manufacturer. Pipe selection for diameters, wall thickness, and installation techniques should conform to latest edition of ASTM-F480 and the "Manual of Practices for the Installation of Thermoplastic Water Well Casing," developed by the National Ground Water Association (http://www.ngwa.org/) and the Plastic Pipe Institute (http://www.plasticpipe.org/).

According to ASTM-F480, thermoplastic well casing pipe should be marked at least every 5 feet in letters not less than 3/16 inch high in a contrasting color with the following: nominal casing pipe size; casing pipe SDR; type of plastic used (ABS, PVC, or SR); the impact classification (for example, IC-3); ASTM designation F480; the manufacturer's name or trademark; and the manufacturer's code for the lot number, and date of resin manufacture. Thermoplastic well casing intended for potable water also should include the seal or mark of the laboratory making the evaluation for potable water use, spaced along the casing at intervals specified by the laboratory.

Table 4
Diameters and Tolerance for Thermoplastic Water Well Casing and Pipe (ASTM F-480)

Nominal Pipe Size	Average Outside Diameter Tolerance in Inches	On Average Outside Diameter Tolerance in Inches	Out-of-Roundness Tolerance for SDR-26 and SDR-21	Out-of-Roundness Tolerance for SDR-17 and SDR-13.5
5	5.563	0.010	0.050	0.030
6	6.625	0.011	0.050	0.035
8	8.625	0.015	0.075	0.045
10	10.750	0.015	0.075	0.050

Table 5
Wall Thicknesses and Tolerances for Thermoplastic Water Well Casing in Inches

	Minimum Thickness[1]	Minimum Tolerance[2]
SDR-26 **Nominal Pipe Size**		
5	0.214	0.027
6	0.255	0.031
8	0.332[3]	0.040
10	0.413[3]	0.050
SDR-21 **Nominal Pipe Size**		
5	0.265[3]	0.032
6	0.316[3]	0.038
8	0.410[3]	0.049
10	0.511[3]	0.061
SDR-17 **Nominal Pipe Size**		
4	0.327[3]	0.039
6	0.390[3]	0.047
8	0.508[3,4]	0.061
10	0.632[1,2]	0.076

[1]The listed dimension is the lowest acceptable wall thickness at any cross section of the casing pipe
[2]Thermoplastic casing can only exceed the minimum thickness by the listed amount
[3]Meets or exceeds Schedule 40
[4]Meets or exceeds Schedule 80

	Minimum Thickness[1]	Minimum Tolerance[2]
SDR-13.5 Nominal Pipe Size		
4	0.412[3,4]	0.049
6	0.491[3,4]	0.058
8	-------	-------
10	-------	-------

[1]The listed dimension is the lowest acceptable wall thickness at any cross section of the casing pipe
[2]Thermoplastic casing can only exceed the minimum thickness by the listed amount
[3]Meets or exceeds Schedule 40
[4]Meets or exceeds Schedule 80

7. The casing of any well should project at least 12 inches above the pump house floor or finished ground surface, and at least 24 inches above the highest flood level of record. No casing should be cut off below ground surface except to install a pitless adapter. Likewise, a pitless adapter should project at least 12 inches above ground surface.
8. There should be no opening in the casing below its top except for a properly installed pitless adapter. The upper terminus of the pitless adapter should comply with Section 4.8 concerning vents. A pitless adapter should be attached to the well casing by threading or welding in a manner that will ensure a watertight permanent connection. The adapter fitting should be a commercially produced casting or shop-welded fitting, pressure tested to at least 100 pounds per square inch, with no weeping or leakage. Saddle-type fittings with heavy corrosion-resistant U-bolts and rubber gaskets are acceptable if the system will be under pressure at all times. The pitless adapter should be designed to prevent the pump column pipe from dropping into the well if there is misalignment during assembly, or during installation or reinstallation the pitless adapter's internal parts.
9. A well casing should never be used as a suction pipe.

2.3 Sealing

The annular space between the well casing and the bore hole must be properly sealed with neat cement grout or bentonite clay grout, to prevent the entry of contaminants into the aquifer.

1. The casing of a well completed in rock should be firmly seated in sound rock. If broken or creviced rock is encountered above the aquifer, the casing should be seated in sound rock. In areas where a rock well can be developed only in the upper fractured rock, the casing may terminate in this formation if there is at least 25 feet of unconsolidated material above the rock. When there is less overburden and deeper strata will not produce potable water, the sub-standard quality of the well must be recognized. Your local health department or the State Department of Health can be consulted for advice on treatment necessary to provide a safe supply.
2. In a rock well, the annular space between the casing and the drill hole should be sealed to a sufficient depth to prevent surface drainage water, or shallow subsurface drainage, from entering the hole. If rock is encountered within 25 feet of the surface, the hole should be reamed at least 4 inches greater diameter than the outer diameter of the casing so that a minimum 2-inch annular space is created that can be filled with grout. The casing should be extended at least 10 feet into rock, or to a point at least 25 feet below the surface, whichever is deeper, and the annular space grouted.
3. If neat cement grout is used to seal a bore hole it should be composed of a thorough mixture of Portland cement and clean water at a rate of one bag (94 lbs.) of cement to 5 to 6 gallons of water so that it can be pumped or puddled into the annular space to seal it. If neat cement grout cannot be placed effectively, additives may be used provided shrinkage is held to a minimum and the mixture will form a watertight seal throughout the entire depth required to prevent objectionable waters from entering the hole.
4. Where pipe is driven through clay, silt, sand, or gravel into a hole of smaller diameter than the casing, bentonite clay grout may be used to seal the annular space. Bentonite clay should be puddled around the point where the casing enters the ground in order to maintain a seal around the drive pipe and couplings and to serve as a lubricant while driving the casing.
5. Whenever a casing is placed in a hole of larger diameter than the casing, the annular space between the casing and the wall of the hole should be at least 1-inch minimum. The annular space should be sealed vertically from the rock or screen setting to the surface with either bentonite clay or neat cement grout in the manner described in "C" or "D" above.

2.4 Screens

Wells drawing from unconsolidated water-bearing formations should be fitted with screens having the maximum open area consistent with strength of the screen and the size of materials in the water-bearing formation or gravel pack. The openings should permit maximum transmissivity without clogging or jamming. Recommended screen materials

include stainless steel, fiberglass, PVC, and ABS. Slotted pipe or iron or mild steel screens are unacceptable. To prevent deposition in and around screen openings, the well screen should have a total opening area sufficient to allow water entry through the screen at a maximum velocity of 0.1 feet per second.

2.5 Temporary Caps

A temporary cap should be placed on a well until pumping equipment can be installed, to prevent insects, rodents and other contaminants from entering the casing.

2.6 Plumbness and Alignment

Each drilled well should be tested for plumbness and alignment. The bore of the hole should be sufficiently plumb and straight that the casing will not bind as it is installed. The casing should be sufficiently plumb and straight that it will not interfere with installation and operation of the pump.

2.7 Construction Water

Water used in drilling should be potable, so that the well and water bearing formations penetrated do not become contaminated. Water from creeks and ponds is unacceptable. As an added precaution, water used during drilling should be treated to maintain a free chlorine residual of 100 milligrams per liter (mg/l).

2.8 Records

The well driller should furnish the owner with a duplicate copy of the information he or she is required to submit to the Indiana Department of Natural Resources (http://www.in.gov/dnr/) in accordance with Rule 312 IAC 13-2-6 (http://www.in.gov/legislative/iac/title312.html), including:

1. Method of well construction;
2. Proposed use of the well (for example, residential, industrial, monitoring, or dewatering);
3. Type of pump and the depth of pump setting;
4. Whether the well was bailer, air, or pump tested;
5. Test rate and length of time of test pumping;
6. Specifications for the well casing and the well screen;
7. Inside diameter of the well;
8. Total depth of the well;
9. Static water level in the well;
10. Name and address of the well driller;

11. Name and license number of the equipment operator;
12. Type and thickness of formations or materials encountered, including color, hardness, and a geological description;
13. Type, depth, and thickness of grouting materials and the method of grout installation; and
14. Directions to the well, including a reference to the nearest major highway or street intersection.

Other Issues

3.1 Disposal Prohibited

No well or well-like structure may be used for the disposal of sewage, waste, or drainage or other material that might contaminate potable water. All disposal wells must be approved by the Indiana Department of Environmental Management (http://www.in.gov/idem/) prior to construction.

3.2 Recharge or Return Wells

If a well is to be used to return uncontaminated water to an aquifer, the return water must not be aerated. It is important to minimize other adverse changes in return water quality, as compared to natural groundwater quality. The return pipe should discharge at least 5 feet below static water level in the return well. The screen of a recharge well should have two to three times the open area that would be provided for a comparable supply well.

3.3 Well Abandonment

If a well is to be abandoned, it must be properly sealed to restore, as far as possible, the hydrologic conditions that existed before the well was drilled. An improperly abandoned well is an uncontrolled invasion point for contaminated water. Unsealed wells are a hazard to public health, safety, welfare, and to the preservation of our groundwater resource. Sealing of wells presents a number of problems, dependent on construction of the well, the geological formations it penetrates, and hydrologic conditions. A properly sealed water well will: (1) eliminate the physical hazard; (2) prevent groundwater contamination; 3) conserve the aquifer's yield; 4) maintain the aquifer's hydrostatic head; and (5) prevent intermingling of waters when more than one aquifer is involved. The Indiana Department of Natural Resources (http://www.in.gov/dnr/) addresses proper well abandonment in its Rule 312 IAC 13-10 (http://www.in.gov/legislative/iac/title312.html).

Water System Installation

4.1 Water System Installation and Construction

Every pump and water system should:

1. Be durable in design and construction, and properly sized to produce the volume of water necessary for the intended use.
2. Be designed appropriately for well's characteristics.
3. Protect against contamination of any sort from surface or subsurface sources.

4.2 Upper Well Terminal

Well casings and pitless adapters should terminate a minimum of 12 inches above the finished grade, and at least 24 inches above maximum flood level as determined by the Indiana Department of Natural Resources (http://www.in.gov/dnr/). Well casings should not be cut off below ground level except to install a pitless adapter.

4.3 Pitless Adapters

Pitless adapters are designed to replace the upper section of a well casing, thus serving as the terminus of the well. They are designed to be field attached to the well casing, and the discharge piping that connects to the side of the pitless adapter is designed to be pressurized by the water system at all times. The cap, casing cover or sanitary seal should be self-draining and overlap the top of the pitless adapter casing with a downward flange. There should be no openings in the pitless adapter cap, within the diameter of the pitless casing except for a factory-installed vent. Pitless adapter vents should comply with the Section 4.8.

4.4 Vertical Turbine Pumps

A vertical turbine well pump should be mounted on the well casing, a pump foundation, or a pump stand, to provide an effective well seal at the top of the well. Further, the pump should be mounted on a base plate or foundation in a manner that will prevent dust and insects from entering the well.

4.5 Submersible Pumps

Submersible pumps should have at least one check valve located in the discharge pump column pipe from the pump, inside the well casing. Therefore, a check valve is not needed on the piping between the well and the pressure tank. A watertight expanding gasket or equivalent well seal should be provided to seal inside the well casing and around the discharge pipe and conduit containing the power cable for the pump.

4.6 Pump Houses

Unless the pump is submersible it should be installed at a weatherproof, frost-proof location. Pump controls should be similarly located. Any protective structure should permit removal of the pump and column pipe for maintenance and repair. The pumphouse floor should be constructed of impervious material, and slope away from the well in all directions.

4.7 Protection Against Freezing

All water system components, especially water lines, should be protected from freezing. Based upon past history, water lines in Indiana should be buried at the following minimum depths to preclude freezing (measured in inches from the top of pipe to finished grade):

Minimum Depths for Water Lines to Prevent Freezing

County	Bury Depth	County	Bury Depth	County	Bury Depth
Adams	60	Hendricks	54	Pike	42
Allen	60	Henry	54	Porter	60
Bartholomew	48	Howard	60	Posey	42
Benton	60	Huntington	60	Pulaski	60
Blackford	60	Jackson	48	Putnam	54
Boone	54	Jasper	60	Randolph	54
Brown	48	Jay	60	Ripley	48
Carroll	60	Jefferson	42	Rush	54
Cass	60	Jennings	48	St. Joseph	60
Clark	36	Johnson	54	Scott	36
Clay	54	Knox	48	Shelby	54
Clinton	54	Kosciusko	60	Spencer	36
Crawford	36	LaGrange	60	Starke	60
Daviess	48	Lake	60	Steuben	60

County	Bury Depth	County	Bury Depth	County	Bury Depth
Dearborn	48	LaPorte	60	Sullivan	54
Decatur	48	Lawrence	48	Switzerland	42
DeKalb	60	Madison	60	Tippecanoe	60
Delaware	60	Marion	54	Tipton	60
Dubois	42	Marshall	60	Union	48
Elkhart	60	Martin	48	Vanderburgh	36
Fayette	54	Miami	60	Vermillion	60
Floyd	36	Monroe	48	Vigo	60
Fountain	60	Montgomery	60	Wabash	60
Franklin	48	Morgan	48	Warren	60
Fulton	60	Newton	60	Warrick	36
Gibson	42	Noble	60	Washington	36
Grant	60	Ohio	42	Wayne	54
Greene	54	Orange	42	Wells	60
Hamilton	54	Owen	54	White	60
Hancock	54	Parke	60	Whitley	60
Harrison	36	Perry	36		

4.8 Vent Piping

Vent piping should be sized to allow rapid equalization of air pressure in the well. A minimum of ½-inch piping should be utilized. Vent openings should terminate at least 12 inches above finished grade; be turned down; be secured in position; be reasonably tamper-proof; and be screened with not less than a 24-mesh screen or else filtered in a manner that will prevent the

entry of insects. Pay particular attention to venting of wells in areas where toxic or flammable gases are known to be a characteristic of the water. In such cases, all vents should discharge outside at a height where the gases will not accumulate or otherwise pose a hazard.

4.9 Pump Bearing Lubrication

Pumps should be of a type that use water for lubrication of the pump bearings. If a storage tank is required for lubrication water, it should be designed to protect the water from contamination. Oil lubricated line shaft turbine pumps are not acceptable for use in potable water systems.

4.10 Sampling Faucets

A water system should include a sampling faucet for collection of water samples, installed on the discharge piping from the pump, prior to chlorination or any other treatment. The sampling faucets should be a minimum of ½-inch I.P.S., have a smooth end, and a turned-down nozzle. Hose bibs are unacceptable, because their threaded nozzles prevent collection of representative bacteriological samples.

4.11 Buried Pump Suction Pipes

All buried suction pipes should be enclosed in conduit having a minimum wall thickness equivalent to a well casing of the same size, and the annular space should be constantly subjected to water system pressure. Buried suction pipes should be located in accordance with Section 1.2. Suction pipes should never be located under a sewer.

4.12 Offset Pumps and Pressure Tanks

Offset pumps and pressure tanks should be located where they are readily accessible. They should not be located in a crawl space unless the crawl space is drained to the ground surface beyond the crawl space, preferably by gravity (rather than by use of a sump pump). There should be a minimum of 4 feet clearance between the floor of a crawl space and the floor joist overhead, to allow for servicing. Pumps and pressure tanks should be located within 5 feet of the crawl space entry. The crawl space access opening should be at least 2 feet high and 2 feet wide.

4.13 Materials Prohibited

No material should be used in the well or pump installation that could contaminate the aquifer or the water produced, or cause an objectionable taste or odor.

4.14 Feeding Treatment Chemicals into Wells

During normal operation no chemical other than sodium hypochlorite should be fed into a well. If the water pumped from a well must be chemically treated, it must be accomplished in a manner that will prevent accidental backfeed or back siphonage of the treatment chemical into the well.

Disinfection And Samples

5.1 Disinfection

The contractor is responsible for properly disinfecting any new well or well subjected to repairs or pump maintenance, upon completion of the work. Likewise, a pump installer must disinfect the well after the pump is installed, or repaired. Sufficient chlorine solution should be introduced into the well and water system to insure a minimum dosage of 100 mg/l. This chlorine solution should remain in the well and water system for a minimum of 24 hours. However, after 24 hours at least 25 mg/l of chlorine should still remain in the water. Under these conditions the well need not be disinfected again until the pump is set.

CAUTION: When working with chlorine, a person should be in a well-ventilated place. Chlorine powder or liquid should not come in contact with the skin or clothing. Chlorine solutions are best handled in wood, plastic or crockery containers because metal containers will corrode.

Every new, modified or reconditioned water source, including pumping equipment and the gravel used in gravel wall wells, should be similarly disinfected before the well is again placed into service. Such treatment should be performed when the well work is finished and again when the pump is installed or reinstalled.

1. Use Table 6 to determine the amount of water in a drilled or driven well, based on casing size and the total depth of the well:

Table 6
Water in Gallonage of a Drilled or Driven Well

Diameter of Well Casing in inches	Gallons per foot
5	1.00
6	1.50
8	2.60

2. For each 100 gallons of water in the well, calculated from Table 6 above, use 3 cups of liquid laundry bleach (5.25% chlorine) or 2 ounces of hypochlorite granules (70% chlorine). Mix the calculated amount of chlorine in about 10 gallons of water. For your convenience in measuring out the correct amount, the following conversion factors are listed:2 cups = 1 pint
   4 cups = 1 quart
   16 ounces = 1 pound
3. Pour this solution into the well making sure the casing walls are wetted before the seal or cap is installed.
4. Connect one or more hoses to faucets on the discharge side of the pressure tank and run them into the top of the well casing. Start the pump, circulating the water back into the well for a least 15 minutes. Then open each faucet in the system until a chlorine smell or taste appears. Close all faucets. Seal the top of the well.
5. Let stand for at least 12 hours, preferably 24 hours.
6. After standing, run the pump to discharge water from each outlet until the chlorine odor and taste disappears.

5.2 Water Samples

After pumping the well and water system to remove the disinfectant, collect a water sample from the system using a sterile bottle provided by a laboratory that is certified to perform bacteriological analyses. Before the installation can be placed in service for human consumption, the water sample collected should have less than two coliform organisms per 100 milliliters of water. If the first sample is unsatisfactory, the disinfection procedure should be repeated and another sample collected for analysis. This procedure should continue until test results are satisfactory.

In addition to bacteriological testing, all new wells should be sampled for chemical analysis. The analysis should include all parameters listed in Table 7 below:

Table 7
Water Test Parameters and Drinking Water Standards

Test Parameter	State/Federal Drinking Water Standard	Aesthetic Recommendation
Total hardness, as CaCO3	----	----
pH	----	----
Specific conductance, in mhos	----	----
Alkalinity (Total) as CaCO3	----	----
Arsenic	0.01 mg/l	----
Chlorides, as CI	----	250 mg/l
Dissolved solids	----	500 mg/l
Iron, as Fe (Total)	----	0.3 mg/l
Manganese, as Mn (Total)	----	0.05 mg/
Nitrates, expressed as Nitrogen *	10 mg/l	----
Nitrates, expressed as Nitrates *	45 mg/l	----
Sulphates	----	250 mg/l
Fluoride	4 mg/l	1 mg/l

*** Only one test needs to be performed for nitrates. However, a laboratory can report the results of its nitrate testing in either of the ways listed.**

If a resident has been advised by a physician to limit their dietary intake of sodium it is recommended that the water also be tested for sodium, so that source of sodium intake can be factored into the resident's total diet. If a water softener will be installed for treatment,

then that source of sodium input to the water should also be factored into the resident's total diet. It also is desirable to test in the field for hydrogen sulfide.

It is the well owner's responsibility to obtain the required samples and have the laboratory tests made. Copies of the bacteriological and chemical analysis reports should be filed by with the Indiana Department of Natural Resources (http://www.in.gov/dnr/).

The well driller and/or water system installation contractor should construct and install the well and/or water system in accordance with these standards and acceptable industry practices. If these criteria are met, the well driller and water system installation contractor should not be responsible for the quality or quantity of water obtained.

5.3 Qualifications

In accordance with Indiana Code 25-39 (http://www.ai.org/legislative/ic/code/title25/ar39/index.html) and Rule 312 IAC 13 (http://www.in.gov/legislative/iac/title312.html), all water well drillers must be licensed by the Indiana Department of Natural Resources (http://www.in.gov/dnr/).

Special Circumstances

6.1 Local Ordinances

Several local health departments now require that a permit be obtained before construction of a residential water supply well or installation of a well pump.

6.2 Waivers

If there are special conditions that make it impossible or impractical to comply with these recommendations, your local health department should be consulted for assistance in determining safe alternatives.

Definitions

"Annular space" means the space between two concentric cylinders, such as the space between the bore hole and the well casing. Annular space is usually expressed as a measurement of the difference in radii of the two cylinders.

"Aquifer" means a formation, or formations, that contains saturated permeable material that will yield water to a well.

"Casing" means pipe installed to prevent unwanted solids or liquids from entering the interior of a well.

"Contamination" means the alteration of biological, chemical, or physical properties of water so as to render the water detrimental, injurious, or harmful to health.

"Drawdown" means the difference between the static water level and the pumping water level in a well, commonly expressed in feet.

"Drive pipe" means casing driven into a hole of slightly smaller diameter than the outside diameter of the pipe.

"Groundwater" means that part of sub-surface water which is in the zone of saturation; any water below the water table.

"Pitless adapter" means a watertight unit designed and constructed for permanent attachment to the well casing. A pitless adapter provides a vent, electrical, and discharge pipe connections while preventing contaminants at or near the surface from entering the well. It also permits termination of the well above the ground surface.

"Potable water" means water acceptable for drinking under prevailing government standards.

"Pumping water level" means the level of the water in a well when it is being pumped.

"Static water level" means the level of the water in a well, when no water is being pumped or flows therefrom.

"Well seal" means a removable device used to keep the top of a well casing watertight while permitting penetration of piping, vents and electrical wiring.

"Well vent" means an opening at the top of the well casing that maintains air pressure in the well at atmospheric.

"Yield" means the quantity of water produced from the well per unit of time.